This document includes the Section 2.0, Aircraft Launch and Recovery Equipment (ALRE), of the Draft EPA “Weather Deck Runoff Characterization Analysis Report” published in 2003. The reference number is: EPA-842-D-06-006

DRAFT
Characterization Analysis Report
Weather Deck Runoff

Section 2.0 - Aircraft Launch and Recovery Equipment (ALRE)

2003

2.0 AIRCRAFT LAUNCH AND RECOVERY EQUIPMENT (ALRE)

Aircraft carriers are the only vessels that have aircraft launch and recovery equipment (ALRE) for fixed wing aircraft. This equipment consists of arresting gear for recovering aircraft, catapults for launching aircraft, and jet blast deflectors to divert jet engine exhaust from the flight deck.[2]

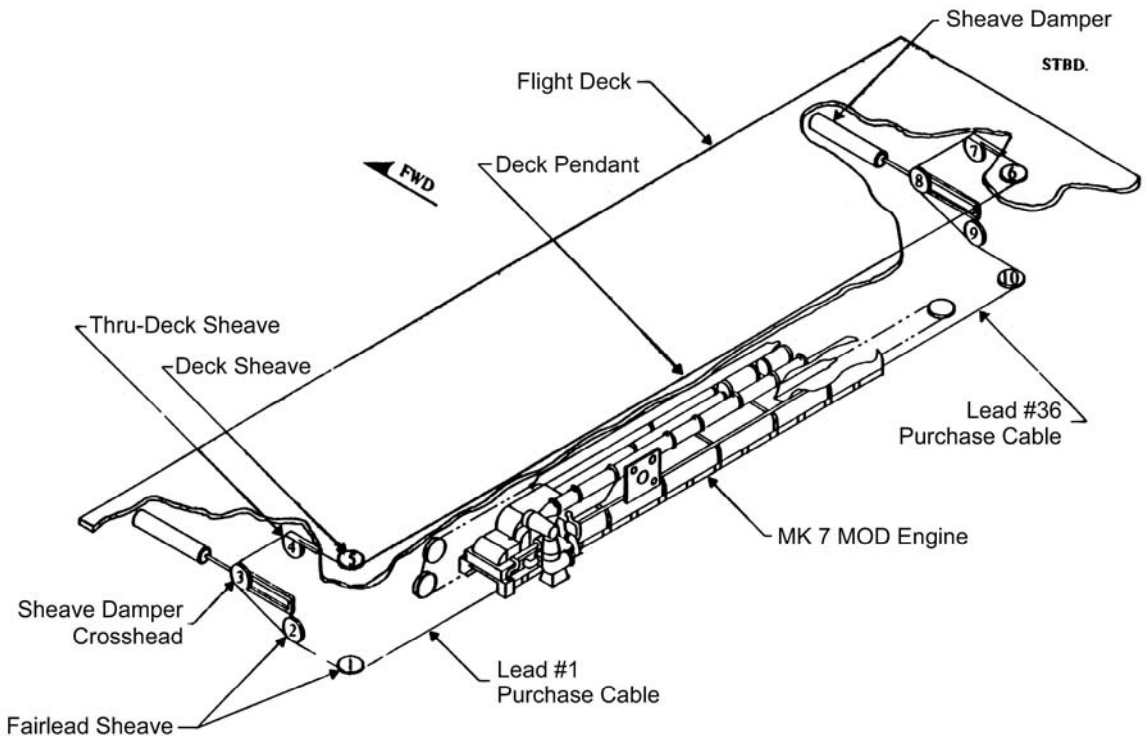
Materials used to maintain the catapults and jet blast deflector enclosures have the potential to enter surrounding waters. The catapult trough enclosure drains present the largest potential for contribution to deck runoff. The design and open track slot of the catapult trough serves as a collection point for all constituents used topside, including aircraft fuel, hydraulic fluid, soot, rain, sea water, and drainage from flight deck washdown evolutions. In addition, the accumulated materials in the barricade stanchion wells and retractable sheave enclosure areas in the arresting gear also have a potential to enter surrounding waters. These areas serve as collection and discharge points for deck runoff; however, most of these discharges occur outside 12 nm during flight operations because the ALRE is disconnected and stowed when not in use. Due to a number of variables such as, number of aircraft launched/recovered, operating temperatures, frequency and amount of rainfall, frequency and amount of "green water" (sea water that washes onto the deck in rough seas), and amount of material used when performing maintenance (each person applies a different amount because no quantity is identified on the maintenance requirement card) (Wenzel *et al*., 2001a), there is insufficient process knowledge to arrive at a plausible estimate.

2.1 ARRESTING GEAR

Arresting gear equipment includes: sheave dampers, fairlead sheaves, barricade stanchions, and various deck equipment (Wenzel *et al*., 2001a) (See Figs 2-1 thru 2-3).

[2] *Amphibious assault ships (LHD 1 and LHA 1 Classes) carry AV-8B Harrier aircraft. These fixed wing aircraft are vertical and short take-off landing (V/STOL) capable and do not require catapults.*

Figure 2-1. Arresting Gear Diagram



The cross deck pendant arresting wires are located on the flight deck. The aircraft tail hook engages one of these four wires. Each cross deck pendant is engaged to a purchase cable which is lead from the arresting gear engine up to the flight deck by a series of grooved pulleys called sheaves. The cutaway diagram shows the arresting gear engine, the system of pulleys, and the cross deck pendant. (Image courtesy FAS Military Analysis Network.)

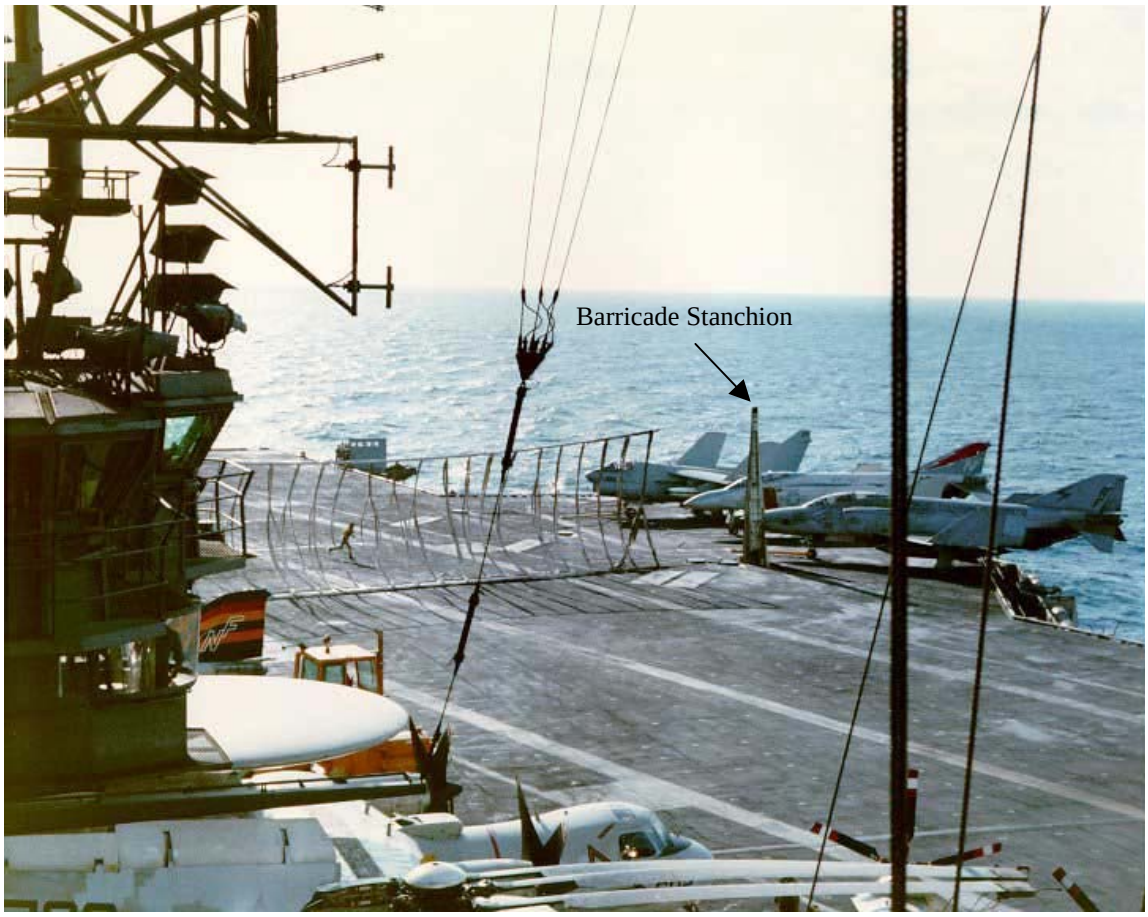
Sheave Dampers. The sheave dampers are located on the 03 level (the third level above the main deck of the ship) immediately below the flight deck and the retractable sheave. The primary function of the sheave damper is to absorb the initial peak shock from the aircraft engaging the arresting gear wire. The damper also guides the arresting gear engine purchase cable to the flight deck. The sheave damper components do not contribute to deck runoff (Wenzel *et al*., 2001a).

Fairlead Sheaves. The fairlead sheaves guide the arresting gear engine purchase cable from the engine to the sheave damper assembly prior to transiting to the flight deck. The fairlead sheaves do not have the potential to contribute to deck runoff (Wenzel *et al*., 2001a).

Barricade Stanchions. The barricade stanchions are housed flush in the flight deck and are used to rig and raise the aircraft emergency barricade recovery nylon webbing assembly (See Figure 2-2). When raised to the full vertical position, the barricade stanchions are 22 ft high. Each stanchion houses two-cable winch assemblies used to tension the barricade webbing. The cables are stainless steel and require no lubrication. The winch assembly gears and stanchion pivoting pins are greased using small amounts of Mobilgrease 28 arresting gear grease (MIL-PRF-81322F). The stanchions are raised hydraulically using the hydraulic cylinder located in the barricade stanchion well. The grease on the tensioning winches and pivoting pins may wash off

during heavy rainfall or during exterior topside surface washdown evolutions; however, the amount is negligible (Wenzel *et al*., 2001a), and the barricade stanchions are rarely in the raised position within 12 nm.

Figure 2-2. Emergency Landing Barricade



This figure shows the emergency-landing barricade set up prior to conducting an emergency aircraft recovery. This system is used in place of the normal arresting gear cross deck pendants, which are retracted prior to deploying the barricade. The landing barricade is used to recover crippled aircraft that cannot make use of the arresting cable. (Photograph by Steve Harr.)

Deck Equipment. Deck equipment includes retractable deck sheaves, wire supports, barricade stanchion components, crossdeck pendant (arresting gear wire), and purchase cable. The gravity drains for the barricade stanchion components and the retractable deck sheaves discharge directly overboard. The retractable deck sheaves guide the arresting gear wire as it retracts following an aircraft recovery. The maintenance materials that have a potential to enter surrounding waters include: Mobilgrease 28 arresting gear grease (MIL-PRF-81322F), Grikote 31EP lubricating oil (no military specification), dry cleaning solvent MIL-PRF-680 type III, and A-A-59313 anti-seize compound. Grikote 31EP is based on a synthetic ester oil with extreme pressure additives (Wenzel *et al*., 2001a).

Figure 2-3. Arresting Gear

Arresting Gear showing retractable deck sheave housing
(Navy photograph by H. Dwain Willis.)

The following tables list the potential discharge materials and narrative parameters observed by the survey team. No quantitative data were available. Constituents remaining on deck surfaces are cleaned during exterior topside surface washdowns. Although residual amounts may contribute to deck runoff, quantitative data were not available. Table 2-1 provides information gathered from Material Safety Data Sheets for the particular Military Specification number listed. No further information is available (Wenzel *et al.*, 2001a).

Table 2-1— Potential Discharge Materials for Arresting Gear

Potential Discharge Material	Potential Discharge Volume (gal/fleet·yr)	Bulk Constituents	CAS #	Composition (%)	Constituent Mass Loading (gal/fleet·yr)	Any BCCs Present?
Arresting Gear Grease (e.g., Mobilgrease 28) (MIL-PRF-81322F)	Unknown	Synthetic oils	—	> 70	Unknown	Unknown
		Additives	—	< 30	Unknown	Unknown
		Sodium nitrite	7632000	Unknown	Unknown	Unknown
Lubricating Oil (Grikote 31EP)	1.7E+03	Petroleum hydrocarbons	—	Unknown	Unknown	Unknown
Anti-seize Compound (A-A-59313)	Unknown	Zinc dust	7440666	42	Unknown	Reduction
		Petroleum grease	8009038	58	Unknown	Unknown
Dry Cleaning Solvent 6850-00-274-5421 (MIL-PRF-680 Type III)	Unknown	High purity hydrocarbon solvents	64771728	100	Unknown	Unknown

BCC = bioaccumulative contaminant of concern
*Note: Information was obtained from military specifications for each material used on the arresting gear. In many cases, different compounds conform to the listed military specification, each having its own material safety data sheet.

Table 2-2— Narrative Parameters for Arresting Gear

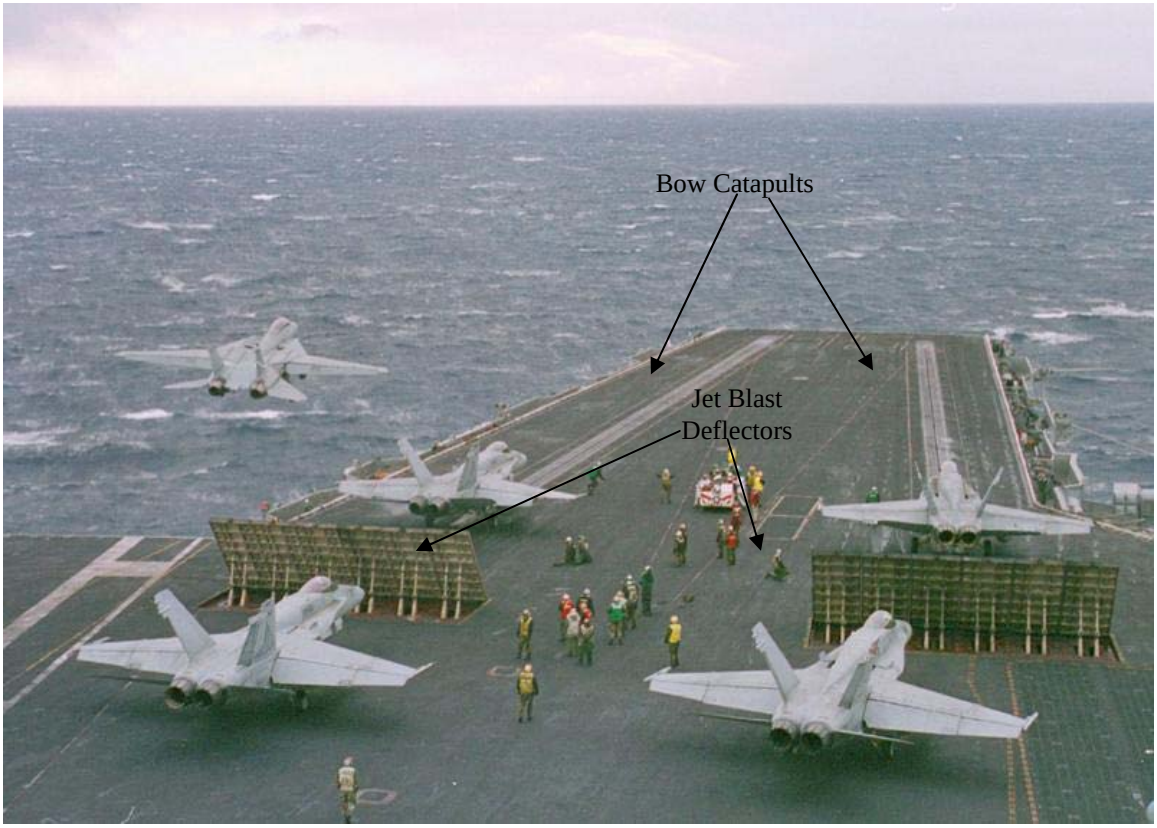
Narrative Parameter	Survey Team Observations
Alkalinity	Unknown-not evaluated
BOD/DO	Unknown-not evaluated
Color	Unknown-not evaluated
Floating Material	Unknown-not evaluated
Hardness	Unknown-not evaluated
Nutrients	Unknown-not evaluated
Odor	Unknown-not evaluated
Oil and Grease	Unknown-not evaluated
Pathogens	Unknown-not evaluated
PH	Unknown-not evaluated
Settleable Materials	Unknown-not evaluated
Specific Conductance	Unknown-not evaluated
Suspended Solids	Unknown-not evaluated
Taste	Unknown-not evaluated
Temperature	Unknown-not evaluated
Total Dissolved Gases	Unknown-not evaluated
Turbidity/Colloidal Matter	Unknown-not evaluated

The need for the information in this table was not recognized at the time of assessment.
The information is based on survey team recollection and consensus.

2.2 CATAPULT OPERATIONS

Catapults. All active carriers are equipped with four steam-powered catapults and associated deck equipment. Each catapult consists of a catapult slot, a control system, and launching and retraction engines. (Wenzel *et al*., 2001a) (See Figure 2-4). A drainage system collects fluids from these engines along with deck runoff water and discharges them near the waterline. This system consists of a trough directly under the catapults to collect the fluids and drainage lines, equipped with duplex strainers, that discharge overboard near the waterline.

Figure 2-4. Catapults with Jet Blast Deflectors



Four F/A-18 *Hornets* wait to launch from the bow catapults of the *USS Enterprise*. The figure shows the bow catapults with jet blast deflectors raised. The catapult has a relatively narrow slot opening in the deck. The catapult trough lies beneath this slot. Each catapult includes two steam cylinders fitted with pistons that provide the motive force for the system. These pistons are fitted to a shuttle that is, in turn, connected to the nose landing gear of the aircraft. Each catapult trough is approximately 5 ft wide, almost 4 ft deep, and approximately 340 ft long. (Navy photograph by Benjamin D. Olvey.)

Launching Engine. The launching engines are located beneath the catapult slots and are enclosed by the catapult trough, which is located immediately below the flight deck. Materials used to maintain and preserve the launching engine equipment have the potential to enter surrounding waters through the catapult drain system. These materials include Aeroshell Grade 120 lubricating oil (SAE J1899), DOD-G-85733 high temperature grease (Bel Ray HT), and MIL-

PRF-680 Type III degreasing solvent. MIL-PRF-680 Type III degreasing solvent is a dry cleaning solvent composed of high purity hydrocarbon solvents (kerosene and alkyl benzenes). The 120 grade lubricating oil is a mixture of 96.5 % petroleum hydrocarbons, 3 % polymethacrylate, and 0.5 % inhibited phenol antioxidant. Approximately 55 % of this oil produces a sludge that makes up approximately 96 % of the material accumulated in the catapult trough that can contribute to deck runoff during heavy precipitation and produce a sheen and floating materials (Opet, 2000; Wenzel *et al*., 2001a).

Control System. The control system for the catapult includes the deck edge launching control station, jet blast deflector control panel, center deck control station, and the integrated catapult control station (ICCS). The control system does not have the potential to contribute to deck runoff (Wenzel *et al*., 2001a).

Retraction Engine. The retraction engine for the catapult is located in the catapult machinery spaces adjacent to the catapult trough. The retraction engine's four cables are connected to the grab assembly located in the catapult trough. The retraction engine provides a means of returning the catapult shuttle and launching engine piston assembly to the battery position in preparation for the next launch. The cables and grab assemblies, which travel in and out of the trough area, are cleaned using MIL-PRF-680 Type III degreasing solvent, and lubricated with DOD-G-85733 high temperature grease. Both products have the potential to enter surrounding waters through the catapult trough drain (Wenzel *et al*., 2001a).

Drainage System. The drainage system begins with a trough that encloses the launching and retraction engines. At several locations in the floor of the trough, drainage pipes collect free liquid and channel it through duplex basket strainers that filter out debris. The drainage pipe travels down through the ship's interior and exits just above the waterline. Normally, open damage control valves are in the line adjacent to where it passes through the hull. Greases and oils from the launching and retraction engines, or from deck top sources can collect on the surfaces of the trough, in the drain lines, or in the strainer. Also, debris that collects in the strainer can be oil or grease coated. Water passes through the drain system, which includes deck runoff draining into the catapult slots and steam condensing on the trough, can pick up constituents from oils and greases and carry them overboard. In addition, bulk quantities of oil can potentially collect in puddles and flow into the drains as the ship rolls.

Associated Deck Equipment. Other deck equipment related to catapult operations includes catapult-launching accessories. Oil and greases used to maintain and preserve this equipment are normally applied to the equipment below decks; therefore maintenance activities do not contribute any constituents to deck runoff (Wenzel *et al*., 2001a). Flight deck operations of deck equipment has the potential to contribute constituents to the deck surface, depending on equipment operating environment, age, and physical condition of the equipment.

Each aircraft carrier is equipped with four catapults. There are two different models of catapults, Mod 1 and Mod 2 (CVN 72 to CVN 76), which use 0.415 gal and 0.83 gal of SAE J1899 per catapult launch, respectively. Based on operating experience, 0.10 gal (for Mod 1) and 0.42 gal (for Mod 2) are discharged overboard via the catapult trough and its drainage system during each catapult cycle. In addition, some lubricating oil is carried with the catapult piston into the water brake tank where it is periodically skimmed off the top of the water and discharged overboard

outside 12 nm.[3] Steam that escapes through the trough slot during operations beyond 12 nm can potentially carry small droplets containing or consisting of oily constituents that can fall to the deck and eventually contribute to deck runoff. The following tables indicate the potential discharge materials and narrative parameters observed by the survey team. Significant amounts of materials will collect in the catapult troughs and contribute to deck runoff via the catapult trough drain system; however, quantitative data were not available. Constituents remaining on deck surfaces are cleaned during exterior topside surface washdowns; however, residual amounts may contribute to deck runoff.

Table 2-3— Potential Discharge Material for Catapult Operation

Potential Discharge Material	Potential Discharge Volume (gal/fleet·yr)	Bulk Constituents	CAS #	Composition (%)	Constituent Mass Loading (gal/fleet·yr)	Any BCCs Present?
Grease (Bel Ray HT) 9150-01-145-1259 DOD-G-85733	3.3E+3	Antimony compound	—	< 1	< 3.3E+1	None
		Molybdenum compound, insoluble	—	10	3.3E+2	None
		Graphite, natural	7782425	5	1.7E+2	None
Aeroshell Grade 120 9150-00-753-4937 SAE J1899	6.4E+3	Mineral oil/ petroleum distillates	—	40 - 50	2.6E+3 - 3.2E+3	Unknown
		Hydrotreated oil	—	50 - 60	3.2E+3 - 3.9E+3	Unknown
Dry Cleaning Solvent 6850-00-274-5421 MIL-PRF-680 Type III	Unknown	High purity hydrocarbon solvents	—	100	Unknown	Unknown

*Note: Potential Discharge Volume varies with operational speed and frequency, temperature, and weather conditions.

[3] *This discharge will be addressed separately under UNDS (Catapult Water Brake Tank and Post Launch Retraction Exhaust) (EPA and DOD, 1999).*

Table 2-4—Narrative Parameters for Catapult Operation

Narrative Parameters	Survey Team Observations
Alkalinity	Unknown-not evaluated
BOD/DO	Unknown-not evaluated
Color	Unknown-not evaluated
Floating Material	Potential exists
Hardness	Unknown-not evaluated
Nutrients	Unknown-not evaluated
Odor	Unknown-not evaluated
Oil and Grease	Potential exists, none observed
Pathogens	Unknown-not evaluated
PH	Unknown-not evaluated
Settleable Materials	Unknown-not evaluated
Specific Conductance	Unknown-not evaluated
Suspended Solids	Unknown-not evaluated
Taste	Unknown-not evaluated
Temperature	Would not change
Total Dissolved Gases	Unknown-not evaluated
Turbidity/Colloidal Matter	Unknown-not evaluated

The need for the information in this table was not recognized at the time of the assessment. The information is based on survey team recollection and consensus.

2.3 JET BLAST DEFLECTORS

Each of the four catapults has a jet blast deflector to deflect the high velocity and high temperature exhaust away from personnel and equipment on the flight deck. The areas of the jet blast deflector that require lubrication are contained within the jet blast deflector enclosure. The sources of deck runoff constituents from jet blast deflectors include lubricating oil (NSN 9150-01-432-0511), grease (NSN 9150-00-823-8047, MIL-G-23549), anti-seize compound (NSN 8030-00-292-1102, A-A-59313), and accumulated jet exhaust soot. The enclosure drains are equipped with a strainer basket that is cleaned prior to entering port, during quarterly maintenance, and as required. Examples of conditions that would require the strainer basket to be cleaned include an accumulation of constituents resulting from heavy rain, flight deck washdown, or fuel spill near the jet blast deflector (Wenzel *et al*., 2001a).

The following tables present the potential discharge materials and narrative parameters observed by the survey team, however, quantitative data were not available. Constituents remaining on deck surfaces are cleaned during exterior topside surface washdowns; residual amounts may contribute to deck runoff (Wenzel *et al*., 2001a).

Table 2-5— Potential Discharge Material for Jet Blast Deflectors

Potential Discharge Material	Potential Discharge Volume (gal/fleet·yr)	Bulk Constituents	CAS #	Composition (%)	Constituent Mass Loading (gal/fleet·yr)	Any BCCs Present?
Grease (GP) 9150-00-823-8047 MIL-G-23549	Unknown	Petroleum hydrocarbons	—	Unknown	Unknown	Unknown
Oil, Lubricating 9150-01-432-0511 (No mil spec)	984	Unknown	—	Unknown	Unknown	Unknown
Anti-seize Compound 8030-00-292-1102 A-A-59313	Unknown	Zinc	7440666	58	Unknown	Reduction
		Petrolatum	—	42	Unknown	Unknown
Jet Exhaust Soot	Unknown	Unknown	—	Unknown	Unknown	Unknown
Dry Cleaning Solvent 6850-00-274-5421 MIL-PRF-680 Type III	Unknown	High purity hydrocarbon solvents	—	100	Unknown	Unknown

*Note: Potential discharge volume varies with operational speed and frequency, temperature, and weather conditions. A full analysis was not conducted on jet exhaust soot, but may contain carbonaceous material, sulfates, and by-products of incomplete combustion of JP-5.

Table 2-6—Narrative Parameters for Jet Blast Deflectors

Narrative Parameters	Survey Team Observations
Alkalinity	Unknown-not evaluated
BOD/DO	Unknown-not evaluated
Color	Unknown-not evaluated
Floating Material	Unknown-not evaluated
Hardness	Unknown-not evaluated
Nutrients	Unknown-not evaluated
Odor	Unknown-not evaluated
Oil and Grease	Unknown-not evaluated
Pathogens	Unknown-not evaluated
PH	Unknown-not evaluated
Settleable Materials	Unknown-not evaluated
Specific Conductance	Unknown-not evaluated
Suspended Solids	Unknown-not evaluated
Taste	Unknown-not evaluated
Temperature	Unknown-not evaluated
Total Dissolved Gases	Unknown-not evaluated
Turbidity/Colloidal Matter	Unknown-not evaluated

The need for the information in this table was not recognized at the time of the assessment.

2.4 PERFORMANCE OBJECTIVE AND ACTIVITIES

The objective for aircraft launch and recovery equipment is for the vessel's responsible party to prevent the discharge of oils, greases, solvents, soot, and other materials associated with ALRE that may negatively impact water quality. Activities that could be performed to meet this performance objective include, but are not limited to: minimizing catapult test launches in port; cleaning and stowing ALRE before transiting within 12 nm; and using an "environmentally compliant"[4] lubricant for catapults or other equipment associated with ALRE.

Catapult no-load testing is required after performing various maintenance actions (e.g., activities involving the launch, hydraulic and/or electrical control systems) to ensure system integrity and safe flight operations (Navy, 1997a). Naval Air Warfare Center Aircraft Division Lakehurst mandated the following procedures to minimize test launches in port: no-load shots in port should be limited to ten, and lubrication shall be activated on the first shot only with the piston assembly in the battery position. If additional no-load shots are required, the previously described process should be repeated with lubrication applied only during the first shot (Navy, 1997d). This activity reduces the number of catapult test launches, thereby reducing the discharge of oil, grease, and soot to deck runoff.

When CV/CVNs plan to be in port for an extended period of time, the arresting gear is disconnected and stowed below decks. When the vessel is going to transit within 12 nm, the cross deck pendant is disconnected from the purchase cable and laid alongside the flight deck. The loose purchase cable is then retracted into the sheave damper spaces (Alexander, 2001). This activity prevents the grease, oil, and anti-seize compounds from contributing to deck runoff. Also, before the CV/CVNs return to port, the catapult trough drain strainer baskets are cleaned and the catapult track slot-seals are installed, which closes off the catapult track slots. This cover protects the catapult from damage while not in use and prevents water from entering the trough, therefore preventing the introduction of additional constituents to deck runoff. The barricade stanchion is cleaned upon returning to port. This cleaning prevents barricade stanchion constituents from contributing to deck runoff.

The Navy is currently implementing an engineering change to replace the currently used catapult lubricant with an "environmentally compliant" catapult lubricant. This engineering change is being implemented on all CV/CVN Class vessels (Weeks, 2001). The "environmentally compliant" catapult lubricant has been tested and evaluated both ashore at Naval Air Warfare Center Aircraft Division Lakehurst and at sea, on CVN 70 (Opet, 2000). [[Removed sentence per Navy comment]] All CV/CVN Class vessels will perform this activity when the elimination of the non-environmentally compliant lubricant is complete. Using environmentally compliant catapult lubricant will reduce the amount of oil residue deposited in the catapult trough by 96 %; thereby reducing the amount of oil contributing to deck runoff (Opet, 2000).

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[4] *Environmentally compliant for this activity, as defined in ECP1-CAT-00130 (Grajek, 2000), means the product meets the requirements set forth in Annex I of Marine Pollution (MARPOL), the Act to Prevent Pollution from Ships (APPS), and the Clean Water Act (Opet, 2000).*